

# (12) UK Patent Application (19) GB (11) 2 289 752 (13) A

(43) Date of A Publication 29.11.1995

(21) Application No 9410249.8

(22) Date of Filing 23.05.1994

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(51) INT CL<sup>6</sup>  
**D06F 58/10 // F26B 21/00**

(52) UK CL (Edition N )  
**F4G GECA G1E2 G1M2 G505 G515 G519 G9RS**

(56) Documents Cited  
**GB 2109520 A GB 2082741 A EP 0094356 A1**  
**US 4662083 A US 4114288 A US 4095349 A**

(58) Field of Search  
UK CL (Edition M ) **F4G GCRA GECA G9RS**  
INT CL<sup>5</sup> **D06F 58/10**  
Online databases: **WPI**

## (54) Clothes dryer

(57) A hot air dryer assembly comprises a first blower 30 for drawing ambient air 40 through heat exchange unit 26 and a finned air heater 28 before directing the heated air 42 into an enclosure. The heated air lowers the relative humidity in the enclosure thereby enabling moisture in articles being dried to evaporate quicker. A second blower 32 in the hot air assembly withdraws moisture laden hot air from the enclosure and expels it through the heat exchange unit 26, where it heats incoming ambient air.

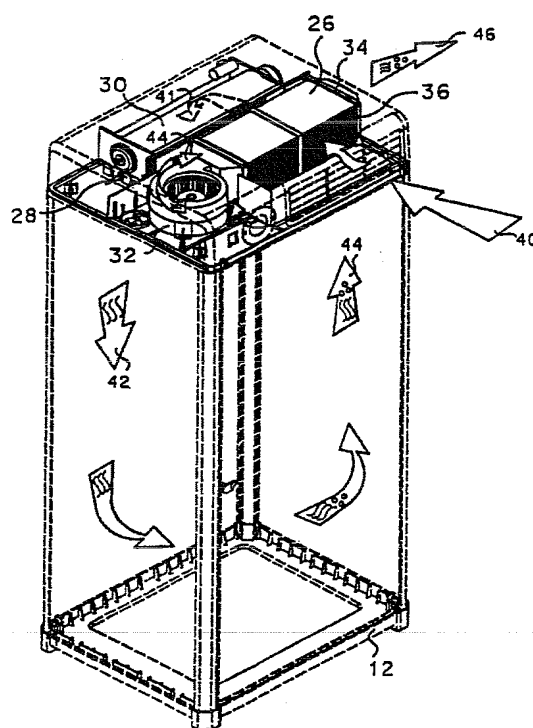


FIG. 3

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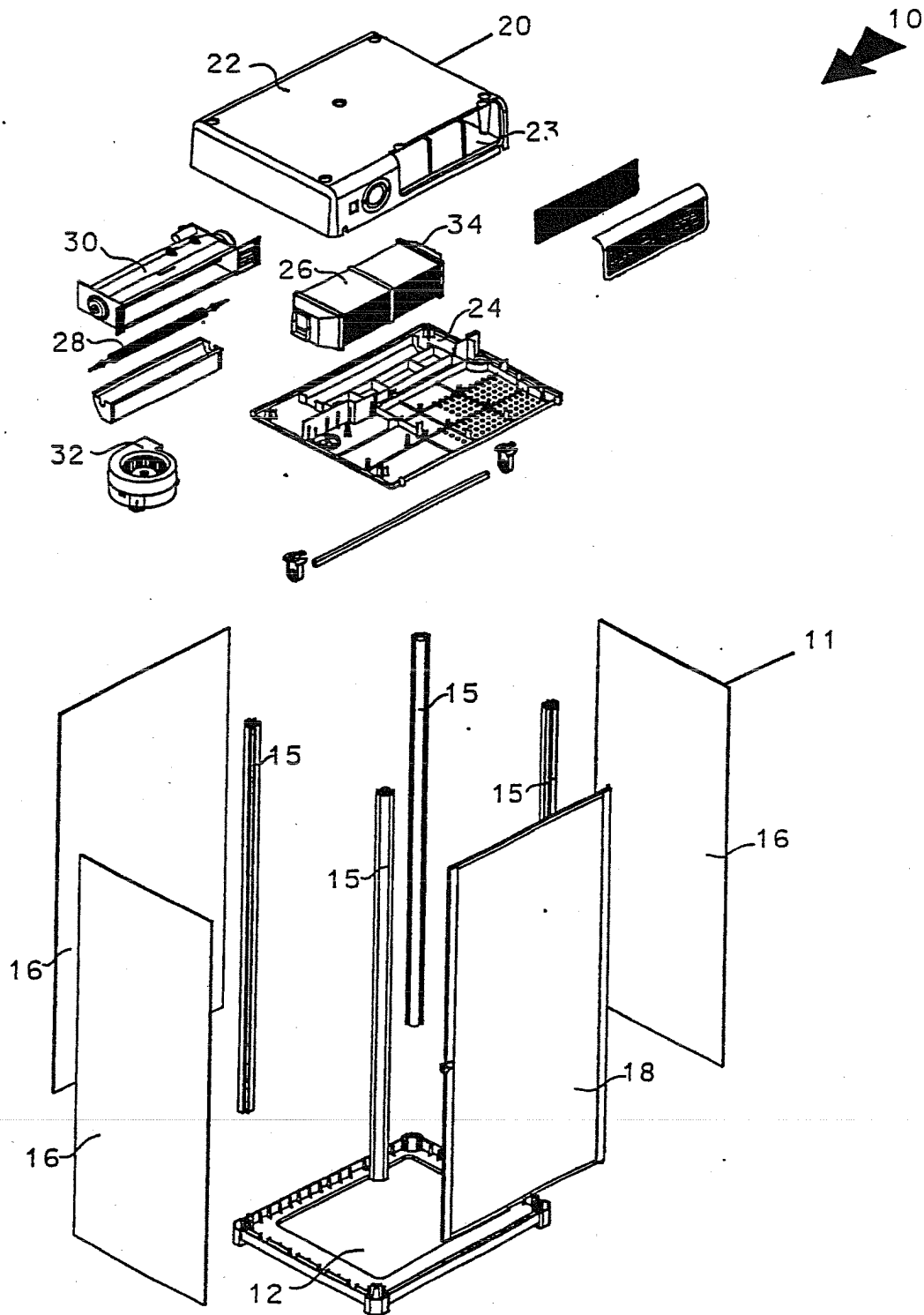


FIG. 1

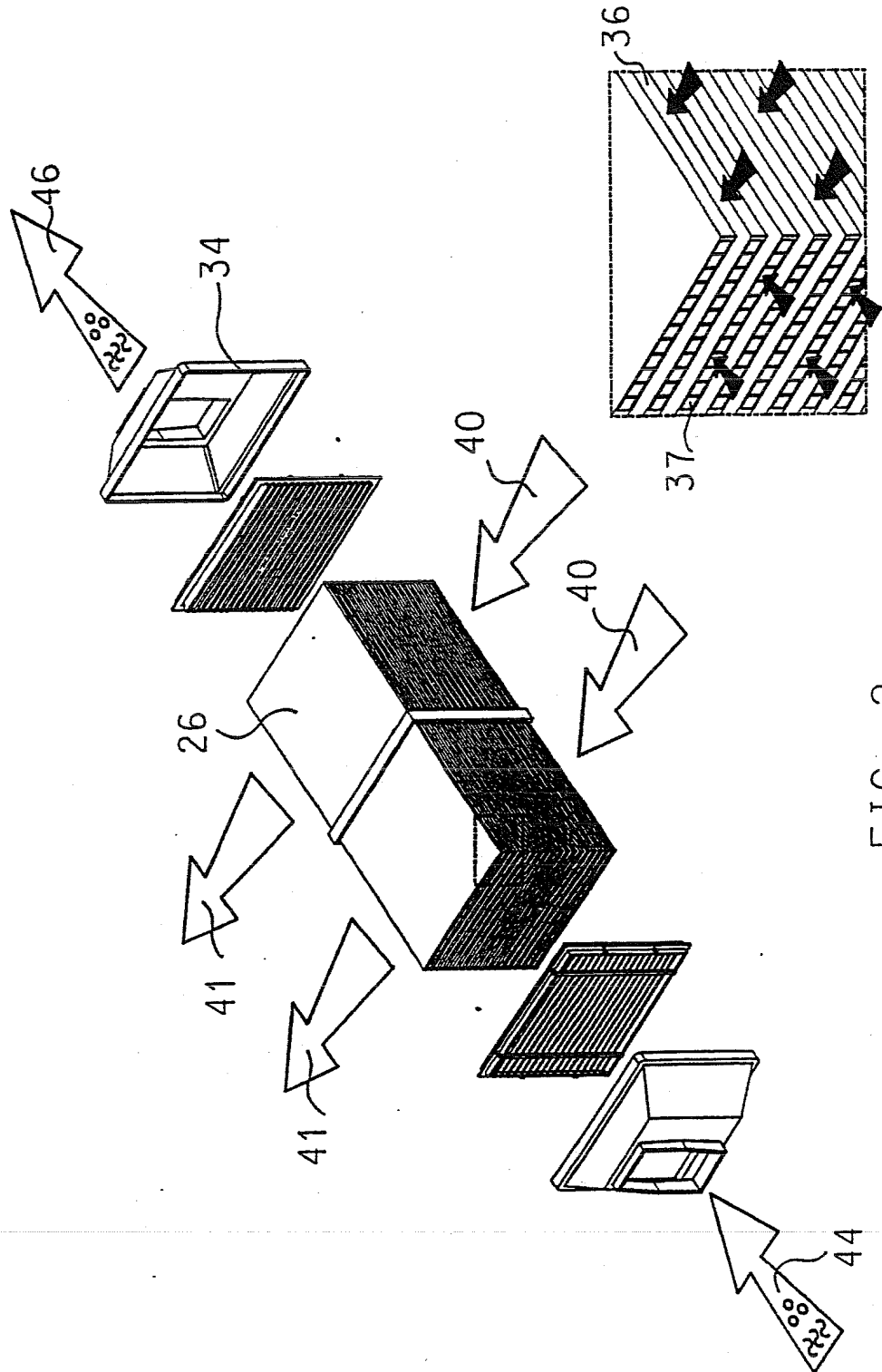


FIG. 2

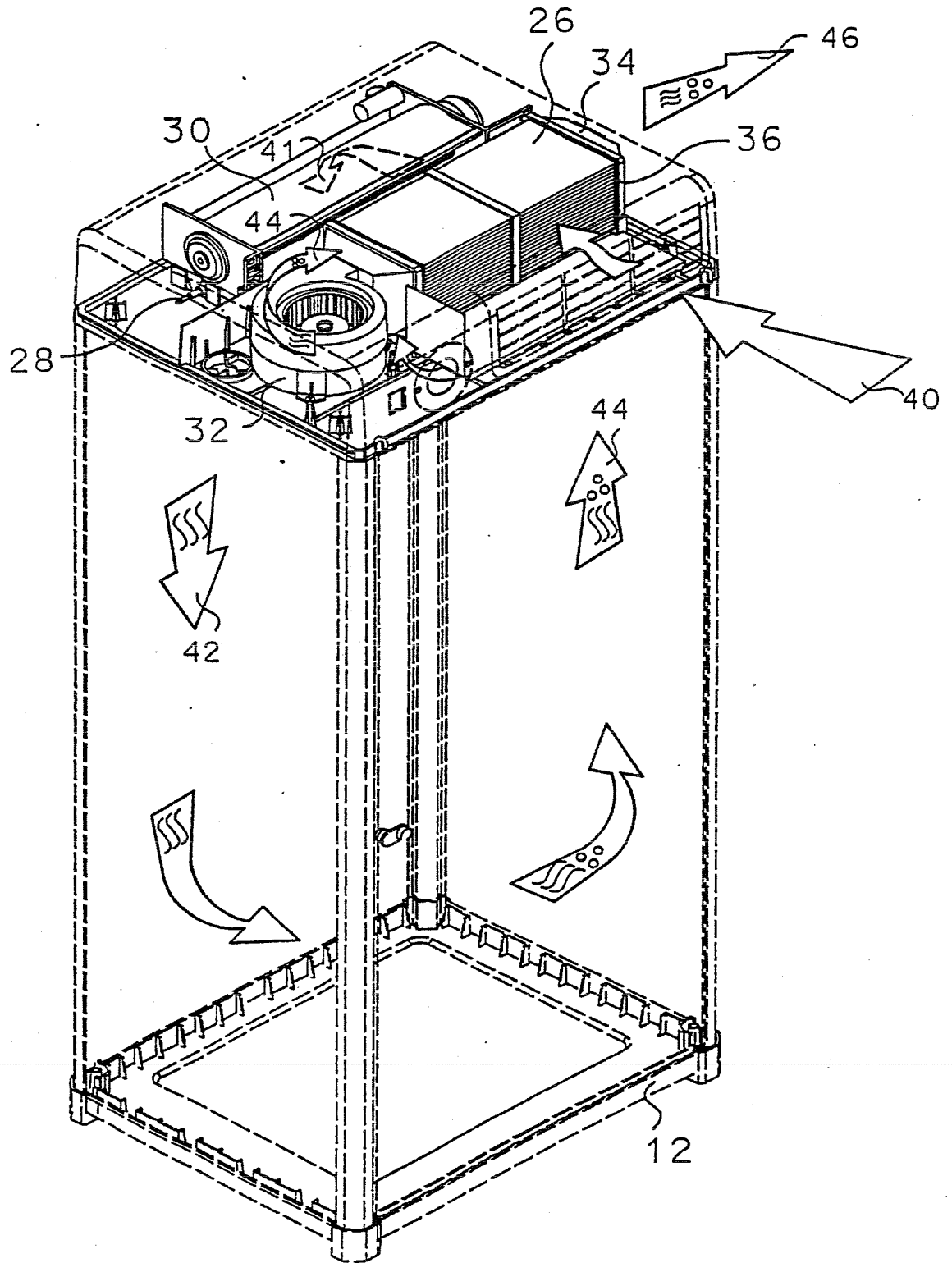


FIG. 3

PORTABLE CLOTHES DRYER

The present invention pertains to the field of apparatus for drying clothes, in particular, this invention describes a hot air dryer for removing moisture efficiently from wet clothes or other articles within an enclosure.

Hot air dryers are well known in the art as exemplified by U.S. patents 4,873,773, 4,875,298 and 4,095,349. '773 discloses a porous bag having a hot air intake duct connected to the register of a household blower heater for receiving hot air and removing moisture from wet clothes suspended within the bag. '298 is a preheater for a clothes dryer which recycles the exhaust hot air over a loop of tubing. The temperature of the ambient air is raised while it passes over the surface of the tubing before it reaches the clothes dryer. As such, less energy is required to dry the clothes. '349 teaches a heat exchange unit to be used with a commercial laundry dryer. Ambient air is brought into heat exchange relationship with the lint and moisture laden hot exhaust gases from the dryer to effect a substantial saving in fuel.

The above mentioned prior art hot air dryers presuppose that either a household blower heater or a laundry dryer is at the user's disposal. In many parts of the world, however, the consumers do not have the use of a clothes dryer because of either it is beyond their means or there is no space.

It is therefore an object of the present invention to describe a hot air dryer which is efficient in removing moisture from wet clothes suspended in an enclosure while consuming as little energy as possible.

- 5 It is a further object of the present invention to describe a hot air dryer which has few parts such that it is not only manufacturable but also versatile and promotes space economy.

The present invention is a do-it-yourself hot air dryer featuring an enclosure  
10 and a hot air dryer assembly. The hot air dryer assembly comprises a tangential blower for drawing ambient air over a heat exchange unit and a finned air heater before directing the heated air into an enclosure. Articles suspended in the enclosure may have moisture removed in the following manner: the heated air lowers the relative humidity in the enclosure thereby  
15 enabling moisture to evaporate quicker; a centrifugal blower disposed in the hot air assembly withdraws moisture laden hot air from the enclosure, and expels it over the heat exchange unit in a cross flow manner with respect to the flow of the ambient air. Thus, the centrifugal blower keeps the relative humidity within the enclosure below 100% at all times, while the heat  
20 exchange unit preheats the inflow of ambient air efficiently.

FIG. 1 is a perspective, exploded view of the present invention showing the hot air dryer and the enclosure.

5 FIG. 2 is a perspective, right side view of the heat exchange unit of the present invention.

FIG. 3. illustrates the flow of ambient air through the present invention where moisture laden heated air from the enclosure is used to preheat the inflow of ambient air.

An apparatus for drying clothes in an enclosure is described below. In the following description, numerous specific details are set forth such as blowers, fan and heater, etc. in order to provide a thorough understanding of the present invention. It will be obvious to one skilled in the art that the present invention may be practised without these specific details. In other instances, well-known parts such as hinges and coupling devices are not shown in order not to obscure the present invention.

FIG. 1 is a perspective, exploded view of the present invention. A hot air dryer 10 comprises an enclosure 11 and a hot air dryer assembly 20. The enclosure 11 further comprises a base 12, a plurality of corner members 15, a plurality of panels 16, and a door panel 18. The components of the enclosures are assembled easily by the end user without assistance from the vendor. The door panel 18 is rotatably coupled to one corner of the base 12 and to one corner of a bottom plate 24 such that the end user may access the interior of the enclosure. The enclosure 11 is open ended at the top such that the bottom plate 24 of the hot air dryer can be fitted onto the top edge of the enclosure.

Referring again to FIG. 1, the hot air dryer assembly 20 comprises a housing 22 having an inlet opening 23, the bottom plate 24, a heat exchange unit 26, a heater 28, a first blower 30, a second blower 32 and an exhaust outlet 34. The heat exchange unit 26 further comprises a plurality of rectangular plates, the function of which shall be elaborated in connection with the description of FIG. 2. The first blower 30 is preferably a tangential blower for drawing and preheating ambient air through the inlet opening 23 and over the heat exchange unit 26. The heated air is further heated as it flows over the heater 28. The first blower 30 also communicates with the



interior of the enclosure 11 such that the heated ambient air can be directed as close to the interior surface of the base 12 as possible. The heater 28 is preferably a finned air heater. The second blower 32 is preferably a centrifugal fan for withdrawing moisture laden heated air from the interior of the enclosure 11. The second blower 32 expels the moisture laden heated air over the heat exchange unit 26 to the exhaust outlet 34. It should be understood by one skilled in the art that the second blower 32 keeps the relative humidity in the enclosure 11 below 100% such that the process of removing moisture from the suspended articles in the enclosure is enhanced.

FIG. 2 is a perspective view of the heat exchange unit 26 of the present invention. The heat exchange unit 26 comprises a plurality of rectangular plates arranged in such a manner to form a first air passageway 36, and a second air passageway 37. These two air passageways are further arranged such that the passages of air flow are perpendicular to each other. Cool ambient air 40 passes through the first air passageway in the heat exchange unit. At the same time, perpendicular to this inflow, moisture laden heated air 44 passes through the second air passageway to the exhaust outlet 34. Therefore, the heat exchange unit of the present invention acts as a preheater system.

FIG. 3 illustrates the flow of ambient air through the present invention where moisture laden heated air from the enclosure is used to preheat the inflow of ambient air. The path of ambient air inflow 40 is drawn by the first blower 30 over the first air passageway 36 of the heat exchange unit 26 before reaching the inlet of the first blower. Said preheated air 41 is further heated by the heater 28 and directed into the interior of the enclosure 11.

The heated ambient air 42 flows towards the bottom of the base 12 and circulates within the enclosure. In the process, moisture from suspended clothes within the enclosure evaporates and permeates the interior of the enclosure. The elevated temperature within the enclosure lowers the relative humidity in the enclosure thereby enabling moisture from the suspended articles to evaporate quicker. The second blower 32 withdraws moisture laden heated air 44 from the enclosure and expels it over the second air passageway (37 as shown in FIG. 2) in the heat exchange unit 26 to the exhaust outlet 34. It is significant to note that the path of ambient air inflow 40 is substantially perpendicular to the path of moisture laden heated air 44 within the heat exchange unit. The heat exchange unit of the present invention preheats the ambient air and economizes on the energy required to remove efficiently the moisture from suspended articles in the enclosure.

While the present invention has been described particularly with reference to FIGS. 1 to 3 with emphasis on an apparatus for drying clothes in an enclosure, it should be understood that the figures are for illustration only and should not be taken as limitation on the invention. In addition, it is clear that the apparatus of the present invention has utility in many applications where moisture removal from fabric or articles such as fruits, flowers or shoes is required. It is contemplated that many changes and modifications may be made by one of ordinary skill in the art without departing from the spirit and the scope of the invention as described.

## Claims

1           1.     In a portable, portable dryer for removing moisture from articles  
2     suspended in an enclosure coupled to said portable dryer, said portable  
3     dryer comprising:

4                 a first blower disposed in said portable dryer for drawing  
5     ambient air and preheating the same, said ambient air forming a first path of  
6     inflow air;

7                 a heater disposed upstream in said first path of inflow air from  
8     said first blower for raising the temperature of ambient air before directing  
9     the heated ambient air into said enclosure;

10                a second blower disposed in said portable dryer for  
11     withdrawing moisture laden heated air from the interior of said enclosure  
12     and subsequently expelling the same, said moisture laden heated air  
13     forming a second path of outflow air; and

14                a heat exchange unit disposed in said portable dryer and  
15     having a first plurality of air passageway upstream in said first path of inflow  
16     air from said heater for receiving ambient air, said heat exchange unit further  
17     having a second plurality of air passageway downstream in said second  
18     path of outflow air for receiving said moisture laden heated air, said first air  
19     passageway being substantially perpendicular from said second air  
20     passageway such that said ambient air flowing through said first air  
21     passageway is preheated efficiently by said moisture laden heated air  
22     flowing through said second air passageway.

1           2.     The portable dryer as in claim 1 where said first blower  
2     comprises a tangential fan, said tangential fan communicating with said first  
3     path of inflow air on one hand and the interior of said enclosure on the other  
4     hand.

1           3.     The portable dryer as in claim 1 where said second blower  
2 comprises a centrifugal fan, said centrifugal fan communicating with said  
3 second path of outflow air on one hand and the interior of said enclosure on  
4 the other hand.

1           4.     The portable dryer as in claim 1 where said heater comprises a  
2 finned air heater.

1           5.     The portable dryer as in claim 1 where said enclosure  
2 comprises a plurality of semi-rigid panels, said panels forming a confined  
3 space where articles can be suspended or supported in an upright position.

1           6.     The portable dryer as in claim 1 where said heat exchange unit  
2 comprises a first plurality of rectangular plates being coupled interleave wise  
3 with a second plurality of spaces, said first plurality of rectangular plates  
4 having first parallel spacers for channeling the flow of ambient air  
5 therethrough, said second plurality of rectangular plates having second  
6 parallel spacers for channeling the flow of moisture laden heated air  
7 therethrough, said first parallel spacers being substantially perpendicular to  
8 said second parallel spacers.

1           7.     A portable dryer substantially as hereinbefore described with  
2 reference to or as shown in th accompanying drawings.

Search Examiner  
ALEXANDER G SMITH

Date of completion of Search  
12 JULY 1994

Documents considered relevant  
following a search in respect of  
Claims :-  
1-7

(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) **ONLINE DATABASE(S):** WPI

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<b>Y:</b>	Document indicating lack of inventive step if combined with one or more other documents of the same category.	<b>E:</b>	Patent document published on or after, but with priority date earlier than, the filing date of the present application.
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